

# MASTER OF SCIENCE IN COMPUTER SCIENCE

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## UTILIZING HARDWARE FEATURES FOR SECURE THREAD MANAGEMENT

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**Master of Science in Computer Science-December 1998**

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Transaction processing (TP) applications are of use when solving a wide variety of data processing problems. Current, commercial TP systems do not possess the ability to manage information at multiple security levels with high assurance. Department of Defense (DoD) and Department of Navy Command, Control, Communication, Computers, and Intelligence (C4I) applications handle information over a wide variety of classifications and compartments. The existence of TP applications that can securely process information of different classifications (with assurance) would save the DoD the need to create separate single level systems to process all necessary information.

A trusted computing base (TCB) and security kernel architecture for supporting multi-threaded, queue-driven transaction processing applications in a multilevel secure environment has been designed. Intel's Pentium CPU architecture provides hardware with two distinct descriptor tables. One is used in the usual way for process isolation while the other is used for thread isolation. This allocation, together with an appropriately designed scheduling policy, permits us to avoid the full cost of process creation when only switching between threads of different security classes in the same process. Where large numbers of transactions are encountered on transaction queues, this approach has benefits over traditional multilevel systems.

**DoD KEY TECHNOLOGY AREA:** Computing and Software

**KEYWORDS:** Transaction Processing, Multilevel Secure Operating System, Thread Management, IntelPentium Microprocessor

## A DATABASE APPLICATION FOR THE NAVY COMMAND PHYSICAL READINESS TESTING PROGRAM

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IT21 envisions a Navy with standardized, state-of-the-art computer systems. Based on this vision, Naval database management systems will also need to become standardized among Naval commands. Today most commercial-off-the-shelf (COTS) database management systems provide a graphical user interface. Among the many Naval database systems currently in use, the Navy's Physical Readiness Program database has continued to exist at the command level in a DOS version. This version is outdated since it does not reflect current regulations and lacks many capabilities desired by training coordinators.

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A central question in the design of a graphical user interface is the need to create an application program which will allow Physical Readiness Coordinators at Naval commands to access the Physical Readiness Training database for local personnel in a windows-based environment without the need of a Database Management System environment (such as Microsoft Access). The design recommendations and implementation of a prototype are the primary research areas for this thesis.

**DoD KEY TECHNOLOGY AREA:** Computing and Software

**KEYWORD:** Database

### DESIGN, IMPLEMENTATION, AND TESTING OF MSHN'S RESOURCE MONITORING LIBRARY

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The Management System for Heterogeneous Networks (MSHN) requires the gathering of resource usage information of applications that run within the MSHN system and status information of the resources within the scope of the MSHN scheduler. The MSHN scheduler uses this information to make decisions. This thesis investigates one method of gathering the required information: a client library.

This research develops the mechanism and policy for the client library's resource monitoring role and carefully documents how applications can be easily linked with this client library. During run time the client library gathers information on an application's resource utilization by intercepting system calls and through the use of operating system functions. Resource information gathered includes total runtime, local and remote disk use, network use, memory use, CPU use, and time blocked waiting on user input.

The client library also determines end-to-end perceived status of the resources that the application uses. Specifically, this thesis develops a policy for passively gathering network performance characteristics, i.e., latency and throughput. The per system call overhead added varied from less than 1% to 326%, with an average of 3% overhead added to the run-time of test programs.

**DoD KEY TECHNOLOGY AREA:** Computing and Software

**KEYWORDS:** Wrapper, Passive Monitoring, Intercept System Calls, Library, Resource Monitoring, MSHN, Heterogeneous Computing, Resource Management System